Center Independent Research & Development: JPL IRAD

Ku/Ka/W-band Antenna for Electronically-Scanned Cloud and Precipitation Radar (3CPR)

Completed Technology Project (2013 - 2017)

Project Introduction

Previously, cloud radars such as CloudSat have been separated from precipitation radars such as TRMM (Tropical Rainfall Measurement Mission) and GPM (Global Precipitation Measurement): the next-generation mission will have to address the entire cloud-precipitation process in order to enable significant improvements in climate models. The current work focuses on the development of the Electronically Scanned Antenna (ESA) technologies for a Tri-band (Ku/Ka/W) precipitation AND cloud radar. Such ESA will enable simultaneous Doppler measurement, cross-track electronic scanning, and polarimetry by combining the high gain of a large parabolic-cylindrical reflector with the beam agility of an electronically-scanned feed system.

Development of the key antenna technologies for Tri-band (Ku/Ka/W), scanning precipitation and cloud radar is a required milestone in preparation for one or more missions in the upcoming decadal survey (namely the expected evolution of the Aerosol/Clouds/Ecosystems (ACE) concept and the Global Cloud and Precipitation Measurement (GPCM) mission concept in early formulation by a joint NASA and the Japanese Aerospace Exploration Agency JAXA. Previously, cloud radars such as CloudSat (W-band) have been separated from precipitation radars such as TRMM (Ku Band) and GPM (Ku/Ka Band): the overwhelming scientific consensus is that a next-generation mission will have to address the entire cloud-precipitation process in order to enable significant improvements in weather and climate models. In order to achieve that, scanning, high sensitivity and high range resolution, and high Doppler accuracy are necessary at a set of frequencies capable of detecting all tropospheric cloud and precipitation configurations from cirrus to deep convection: vast experimental evidence shows that this set of frequencies is the union of the GPM (Ku/Ka) and CloudSat (W) bands. Polarimetric capability is also necessary to achieve high Doppler accuracy and detection of mixed phase layers and multiple scattering conditions. The proposed work addresses NASA strategic goals 2.1 and 3 by contributing to the development of an instrument capable of measuring both clouds and precipitation; this will aid the understanding of Earth's climate and environment and will also contribute to innovative technologies to improve the future capabilities of NASA. The need for a single radar capable of addressing both aspects is exemplified by the sub-optimal solution adopted by necessity for the Global Precipitation Measurement radar (Launched in Feb-2014): instead of an actual dual-frequency radar, two single-frequency radars had to be placed next to each other, with significant impact on mission requirements and cost.

The technology development component of this project focuses on two things: first, recent advances in high power electronics allow for higher radiated power with higher efficiencies than ever before. Second, advances in packaging technologies allow us to place more of these electronics closer together and therefore reduce considerably the size of the instrument capable of radiating the necessary amount of energy in the 3 frequencies. The tradeoff

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

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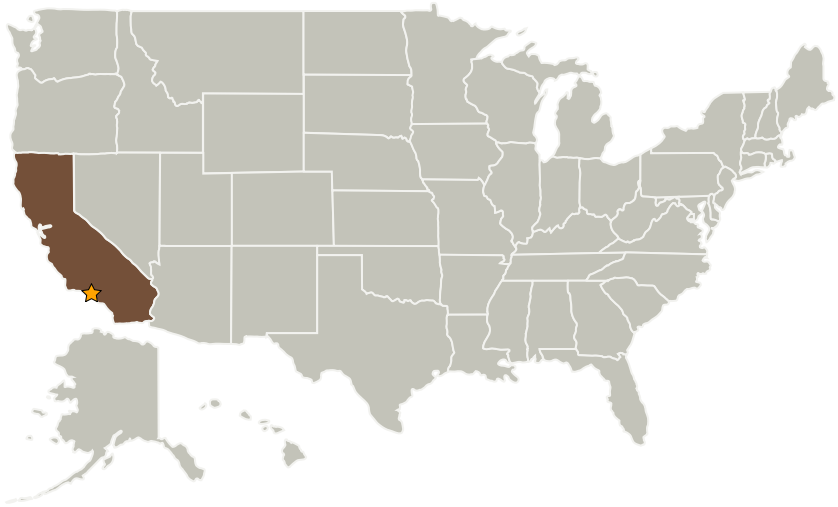
for this size reduction and high level of integration come at the cost of higher dissipated power per volume. One of the key elements of this work is thermal study that will determine is such packed integration is feasible while not overheating the electronics of the instrument.

Anticipated Benefits

This technology development will lay the foundations for the next Cloud and Precipitation mission, part of the upcoming 2017 decadal survey.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

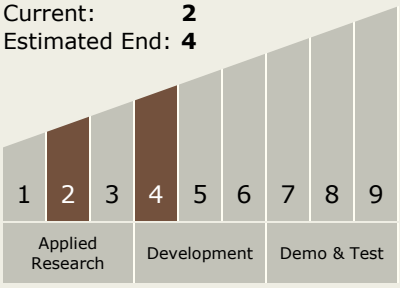
Jonas Zmuidzinas

Principal Investigator:

Mauricio Sanchez Barbetty

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves